Stream Crossing Evaluation for the Proposed Woodland Road

DEQ File No. 09-52-0086-P

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Revisions are stream widths at bankfull elevation at the Middle Branch Escanaba River (Sta. 158+45), Voelkers Creek (Sta. 803+00), and Mulligan Creek Tributary (Sta. 1087+50). The bankfull widths in the January 21, 2010 report were incorrect. The bury depths of the structures are likewise revised at Voelkers Creek to 9" and at the Mulligan Creek Tributary to 8" due to the increased bankfull width. The Middle Branch Escanaba River crossing is a clear span box beam bridge and the structure bury depth is not applicable. All three of the proposed structures still span the revised bankfull widths.

INTRODUCTION

King & MacGregor Environmental (KME) was requested by Mike Smolinski of the Michigan Department of Environmental Quality (DEQ) to evaluate the 23 stream crossings proposed in the application for permit (AFP) for the Woodland Road project in the context of applying the MESBOAC methodology. MESBOAC is an acronym for seven steps of a methodology to design stream crossings. Those steps are:

Match culvert width to bankfull stream width;
Extend culvert length through side slope toe;
Set culvert slope the same as stream slope;
Bury culvert 1/6th bankfull width;
Offset multiple culverts;
Align culvert with stream;
Consider head-cuts and cut-offs.

Of the 23 proposed stream crossing structures in the AFP, six were sized in accordance with detailed survey and engineering design methodology as required by Part 31 and Part 301 of the Natural Resources and Environmental Protection Act, Public Act 451 of 1994, as amended (NREPA). Such methodology includes HEC-RAS studies which are required to determine the influence on water stage during the 100-year frequency flood event. The remaining 17 proposed stream crossing structures are regulated under Part 301 (but not Part 31). These 17 structures were sized to at least match the stream width and were engineered to ensure the conveyance of the 100-year frequency flood event in each watercourse according to the requirements and standards understood to be utilized by the DEQ in administration of NREPA.

METHODS

Derek Stratelak is a Registered Landscape Architect with KME and has been trained in the "Rosgen" natural stream channel assessment methodology. The Rosgen methodology provides extensive training and experience in the determination of a stream's bankfull characteristics Mr. Stratelak evaluated 19 of the 23 proposed stream crossings during his field work of November 30, 2009, and December 1 and 2, 2009. Mike Smolinski

accompanied KME staff for the field investigation on December 2. The proposed stream crossings not evaluated by Mr. Stratelak included the Second River, Wildcat Canyon Creek, Dead River, and Yellow Dog River proposed crossings. These four crossings were not evaluated due to existing site (deep water) conditions which precluded assessment; however other data on these crossings were included in Table 1. Mr. Stratelak estimated the average "bankfull" elevation in the vicinity of each of the proposed stream crossing locations and measured the approximate width of each stream at the bankfull elevation in riffle sections. The width of the bankfull measurement at the bankfull height is important in determining the minimum span size of each stream crossing structure when applying these relatively new methodologies. The proposed structure description and pertinent data on each of those structures are provided in Table 1.

Another important factor in the design and installation of stream crossing structures according to the above-referenced protocols is determining the existing slope of the streambed. Structures should be installed at the same slope as the streambed wherever practical to best ensure the existing stream processes are not impaired. The slope of the streambed is obtained by surveying the elevations of like features (riffles, pools, etc.) of the stream in its thalweg (i.e. the line connecting the deepest parts of a stream) for some distance upstream and downstream of the proposed stream crossing location. The distance traversed upstream and/or downstream varied for each proposed crossing, depending on whether the proposed crossing location was impaired or influenced by features such as the existing road, culverts, or beaver activities.

The slope of the streambed was surveyed for 14 streams; each of the six structures that were engineered using HEC-RAS methodology and eight additional streams where the aquatic resources of the stream appeared to warrant such an approach (e.g. where flows were determined to be perennial and not intermittent). The stream profile information provided for the remaining nine crossings of what appeared to be intermittent watercourses is limited to the existing invert elevation at each end of the proposed culverts.

RESULTS OF THE EVALUATION

Matching Bankfull Width

The width at the bankfull elevation of each of the streams investigated was utilized to determine whether the stream crossing structures proposed spanned the bankfull width. As shown in Table 1, four stream crossing structures were resized to meet or exceed the width of the streams at the bankfull elevation. The streams are Trembath Lake Creek (Sta. 355+50), Wildcat Canyon Creek tributary (Sta. 1002+12), Mulligan Creek tributary (Sta. 1081+00), and Mulligan Creek tributary (Sta. 1097+12). The structures initially proposed were properly sized according to the methodology that has been used and permitted for many years by the DEQ, but were redesigned to meet the MESBOAC standards.

The remaining stream crossing structures span the bankfull width and resizing of these structures was not necessary. Table 2 provides the stream crossing data for all 23 proposed crossings.

Extend Structures to Toe of Slope

The 20 reinforced concrete pipe (RCP) culverts, Conspan bridges, and concrete box culverts extend to the road embankment side slope toe as recommended in the MESBOAC methodology. The three box beam bridges do not have fill over the top of the structure and extending the structure to the toe of the slope is not necessary. Wing walls adequately

isolate the road approach fill from the stream bank at the three box beam bridges.

Set Structures on Stream Slope

The slope of the streambed was surveyed for 14 streams; of those streams six have proposed structures that were engineered using HEC-RAS methodology and eight additional streams where structures are proposed and the aquatic resources warranted this approach.

The six stream crossings that required Part 31 review, including HEC-RAS analysis, are all clear-span structures that will preserve the existing streambed and banks within the structure. Therefore, the stream slope will not be altered and is not a design consideration with these six crossings.

For the remaining eight stream crossings, the stream slope was used to determine the correct elevations of the inlet and outlet invert of the proposed structures when installed. Profile drawings have been prepared and included in a revised Stream Crossing Details & Cross Sections Plans (Application for Permit Table of Contents #13d).

Bury Structures One-Sixth of Bankfull Width

The MESBOAC methodology recommends that the bottom of stream crossing structures be buried in the streambed a depth of 1/6 of the bankfull width of the stream at that location, with a maximum bury depth of two feet. For example, for a stream with a bankfull width of six feet the invert of the structure should be buried one foot in the stream bottom. This part of the methodology is not applicable for bottomless arch culverts or clear-span bridges. The proposed stream crossing structures proposed for the Woodland Road have been designed to comply with this parameter (Table 2).

SUMMARY

The applicant, Woodland Road LLC, has responded to the request by the DEQ to evaluate the proposed stream crossings using the MESBOAC methodology. Although substantial additional cost will be incurred, all of the 23 proposed stream crossings have either been redesigned or the initial proposed design confirmed in order to meet the criteria of MESBOAC.

Note in Table 1 that the revised station locations are provided; “AFP” refers to the station in the application for permit; “Rev” refers to the revised station in the revised plans submitted to the MDEQ on January 21, 2010.

Table 1. Summary of Revisions to Stream Crossing Structure Size and Length for the Proposed Woodland Road.

Stream Name	Station	Initial Proposed Structure Size	January 21, 2010 Revised Structure Size	Length of Structure Initially Proposed	January 21, 2010 Revised Structure Length
5. Trembath Lake Creek	AFP: 355+50 Rev: 356+75	4' X 6' Box Culvert	5' X 7' Box Culvert	160'	70'
16. Wildcat Canyon Creek Tributary	AFP: 1002+12 Rev: 1002+40	42" RCP	84" RCP	85'	85'
17. Mulligan Creek Tributary	AFP: 1081+00 Rev: 1079+00	72" RCP	6' x 8' Box Culvert	98'	92'
19. Mulligan Creek Tributary	AFP: 1097+12 Rev: 1095+10	18" RCP	30" RCP	90'	98'

Table 2. Summary of Stream Crossing Data for the Proposed Woodland Road.

Stream Name	Stream Crossing Station	Existing Structure Size	Proposed Structure Size	Bankfull Width As Measured 12/1/09	Profile Existing Channel For Slope	Structure Bury Depth (min.)	Comments
1. Middle Branch Escanaba River	158+45	None	60' Box Beam Bridge	31.5'	Yes (HEC-RAS)	NA	Proposed structure spans bankfull width and portions of adjacent wetlands and floodplain
2. Second River	213+90	None	53' Box Beam Bridge	Not investi-gated	Yes (HEC-RAS)	NA	Proposed structure spans bankfull width and portions of adjacent wetlands and floodplain
3. Koops Creek	290+75	None	20' Conspan	8.5'	Yes (HEC-RAS)	NA	Proposed structure spans bankfull width and portions of adjacent wetlands and floodplain
4. Second River Tributary	342+64	15"	42" RCP	No bkf	No	NA	Cutoff oxbow; not a stream
5. Trembath Lake Creek	AFP: 355+50 Rev: 356+75	Twin 24"	5' x 7' Box	6.5'	Yes	13"	Road Influenced - 160 foot long structure proposed was revised to 70' long structure

Table 2, continued.

Stream Name	Stream Crossing Station	Existing Structure Size	Proposed Structure Size	Bankfull Width As Measured 12/1/09	Profile Existing Channel For Slope	Structure Bury Depth (min.)	Comments
6. Brocky Lake Trib.	AFP: 494+20 Rev: 497+20	24"	54" RCP	No bkf	Yes	NA	Streambed present down-stream of existing road crossing; upstream is wetland
7. Barnhardt Creek Tributary	569+09	18"	30" RCP	24"	No	4”	Very small watershed
8. Grapevine Road Creek	612+76	24" & 15"	4' x 6' Box	4.5’	No	9”	Dry; has been excavated
9. Conners Creek Tributary	706+65	8"	42" RCP	18" intermitt.	No	3”	Very small watershed
10. Voelkers Creek Tributary	AFP: 796+50 Rev: 797+00	none	24" RCP	20"	No	3.3”	Very small watershed
11. Voelkers Creek	AFP: 802+75 Rev: 803+00	48"	5' x 7' Box	4.6'	Yes	9”	Beaver influenced
12. Dead River	925+00	20’ bridge	24’ Conspan	No bkf	Yes (HEC-RAS)	NA	Beaver influenced
13. Wildcat Canyon Creek	976+70	36"	5' x 7' Box	No bkf	Yes	NA	Beaver influenced
14. Wildcat Canyon Creek	AFP: 991+00 Rev: 990+80	30"	72" RCP	4.5'	Yes	9”	Beaver influenced
15. Wildcat Canyon Creek	AFP: 995+36 Rev: 995+25	24"	54" RCP	30"	Yes	5”	Proposed crossing immediately downstream of existing culvert
16. Wildcat Canyon Creek Tributary	AFP: 1002+12 Rev: 1002+40	24”	84" RCP	6.5'	No	13”	Existing crossing is 200 feet upstream of proposed crossing
17. Mulligan Creek Tributary	AFP: 1081+00 Rev: 1079+00	24"& 36"	6’ x 8’ Box Culvert	7.5'	Yes	15”	7' drop (i.e. waterfall) on downstream end of existing road culvert
18. Mulligan Creek Tributary	AFP: 1087+50 Rev: 1085+50	36"	54" RCP	4.0'	Yes	8”	Very Small Watershed

Table 2, continued.

19. Mulligan Creek Tributary	AFP: 1097+12 Rev: 1095+10	6"	30" RCP	2.5'	No	5”	Very Small Watershed
20. Mulligan Creek Tributary	AFP: 1101+61 Rev: 1099+50	*	18" RCP	15"	No	2.5”	Very Small Watershed; existing culvert buried and not measured
21. Mulligan Creek Tributary	1134+09	None	24" RCP	18"	No	3”	Very Small Watershed
22. Mulligan Creek	1142+65	NA	36' Conspan	17.5'	Yes (HEC-RAS)	NA	Failed timber bridge about 300 feet downstream
23. Yellow Dog River	1288+00	36’	55' Box Beam Bridge	Not investi-gated	Yes (HEC-RAS)	NA	Abutment fill and riprap constrict channel to less than 36’

“No bkf” means that no bankfull elevation was observed..

“NA” means the item is not applicable to that stream.

***** Buried culvert; size & invert unknown.